Indiana University
Multi-campus Modular
Computing Curriculum

Introduction to Computing

Module # 5: Understanding the Hardware

Goals

- Recognize the difference between hardware and software
- Determine relationship between bit measuring terms (bit, byte, K, Meg)
- Be able to decipher the code words in a computer advertisement
- Distinguish between input and output devices
- Identify the major hardware components in a desktop computing system

Prerequisite Skills

- Knowledge of the STAIR problem solving process
- Understanding of essentials of computing

1 Deciphering an Ad

One of the things that intimidates people about computing technology is the horribly complex and obscure jargon that surrounds the field. Some of these terms are vague and complicated, but some are really useful. Today, we are going to discuss those computer terms that you would need to understand if you wanted to go buy a computer. The advertisements in a typical computer magazine appear to be written in some obscure dialect of Serbo-Croation or something. Here is a typical example:

- 120MHz Pentium Processor
- 16MB DRAM
- 850MB 10ms IDE HD

- 1MB DRAM 64-bit PCI Graphics Accelerator Video Card
- 8X CD-ROM
- 3.5" FD
- 16 bit Soundblaster Compat
- 28.8 Fax Modem
- 15 inch Monitor, 15.28 dp
- 7-bay mini-tower case

Believe it or not, this is not too difficult to decipher. By the end of this section, you will have some clue about what kind of a computer that is.

2 Hardware and Software

As you remember from last time, a computer is considered a universal information manipulator. It is universal because it can do many different kinds of things, depending on which instructions are stored in memory. This list of instructions is called a program. Programs are also referred to as software. So far, we have been pretty theoretical about how computers work, but we know that besides the software, they do have a physical entity. The physical pieces you can see are referred to as hardware. A computer system is a combination of both hardware and software.

2.1 Hardware

You are already familiar with the term hardware, as in the hardware store. Hardware, in a more general sense, refers to anything with a physical prescense. Any part of a computer system that can be physically touched and handled (even if you might never actually touch it) is considered hardware. Most of the machines we are used to are mainly hardware. A CD player is hardware, as is the CD. All the stuff in the ad above was hardware.

2.2 Software

One of the things that makes computers so unique is their ability to deal with software. Software is the more esoteric stuff that computers work with. Software is the information and instructions that give computers the 'universal' feel. You have dealt with something like software, even if you have not used a computer very much. Think of this example:

Denise goes shopping for a music CD. She sees a CD she really wants to buy. It costs $17.99! She looks around a little more, and notices that there are other CDs around that only cost $4.00. A friend has told her that it only costs a couple of dollars to create a CD. She wonders why some CDs are more expensive than others. All CDs are physically pretty much the same.

Of course, Denise does know why the CD she wants is more expensive. All the disks cost pretty much the same to manufacture, and they are physically very similar. The only relevant difference between the $4.00 CD and the $17.99 one is the CONTENTS of the disk. The music on the disk is not something tangible. She cannot touch it or see it, but she knows that it is there, and she is willing to pay for it. The real value she is searching for is not the mylar and plastic, but the INFORMATION that the physical entity stores. Information and instructions are software. They are what give the computer such power. Hardware is the physical stuff that makes software possible.

2.3 Firmware

Just for your information, there is something called firmware. As you may have guessed, it is somewhere between hardware and software. (mayonnaise consistency?) It really doesn't come up that often, but it does exist.

3 The Bit and its offspring...

Computers have a number of measurable properties. They vary greatly in speed, capacity, and power. To discuss these differences, we need some new units of measure.

3.1 The Bit

The basic unit of measure in a computer system is the bit. A bit is one on/off switch. It is the smallest unit in computing, and is the foundation for for everything else. Since bits are binary (remember what that means?) they have widespread implications for how information is stored and measured. The binary numbering system and its related systems (base 8 and 16) are used to measure just about everything in a computer system. This explains why the numbers used to measure computers might seem a little odd to us. We are used to thinking in base 10, but the computer will interpret everything in base 2. A number like 255 is not very pretty in base 10, but in binary notation it is 11111111, which is a clean, lovely number. You will often run across numbers like 8, 16, 32, and 64. These numbers are powers of two, so they are nice and clean in binary notation. Just keep this in mind during our discussions today.

3.2 The Byte

While the bit is undoubtedly important, it can only hold two possible values, 1 and 0. In order to represent anything more complex than the simplest binary values, we have to combine bits. Eight bits are combined into a unit called a **byte.** Each bit represents one digit of binary notation. If we put eight of these binary digits together we can represent any number from 0 to 255. Zero would be represented by 00000000 in binary, or all eight bits turned off. If all the bits were on, the largest possible value would be 11111111 binary, which translates to 255 decimal. This is a large enough value to be useful. For example, all the values of the ASCII character set can be represented in one byte. (This is not a coincidence!)

Q. 1 I recently came across an Internet message which claimed that much of the Internet was a conspiracy by big business. One of the author's more interesting theories was that a certain kind of address information called the ip address was limited to a maximum value of 255 rather than 999 deliberately to reduce the supply of addresses and thus make them more valuable. It is true that these addresses have a maximum value of 255. Can you think of another reason this could be the case?

(Answer on page 5-19.)

Q. 2 Many computer monitors are capable of displaying 256 colors at a time. Why this number? Why isn't it 255?

(Answer on page 5-19.)

Q. 3 If you had a document that was 500 bytes long and saved in ASCII format, about how many characters long would the document be?

(Answer on page 5-19.)

3.3 The Kilobyte

Although bytes are much more useful for keeping track of memory than bits, they are still a little small for measuring larger entities, like disk space, file size, and memory capabilities. Some early floppy disks, for example, could hold 368,640 bytes of information. The numbers were getting too big for humans to handle easily. Computer scientists used kilobytes to measure these larger quantities. No doubt you are familiar with the metric system, and you know that a kilo represents a thousand. E.G. a kilogram = 1000 grams, a kilometer = 1000 meters. In computing, a kilobyte **does not** mean exactly one thousand. A kilobyte is 1024 bytes.

Why? It all goes back to the binary system. We like the number 1000 because it is easy to work with in base 10. Computers do not naturally work in base 10, but in base 2. 1000 decimal becomes 1111101000 in binary. This is obviously not a convenient number in binary. Fortunately, the binary value 10000000000 is very easy to work with in binary, and it works out to 1024 in decimal. This is close enough to 1000 decimal that we refer to 1024 bytes as a kilobyte. Kilobyte is often abbreviated K. The 368,640 byte disk we referred to before would be called a 360 K disk.

Q. 4 A later kind of floppy disk was capable of handling 720K. How many bytes is that?

How many bits is it?

(Answer on page 5-19.)

3.4 The Megabyte

The kilobyte is a more convenient unit of measure than the byte, but rapid advances in computing technology made it difficult to work with as well. Computer manufacturers began developing equipment with capacities of many thousands of kilobytes. Once again, computer scientists used a variation of the metric system to save the day. A thousand kilobytes is referred to as a megabyte. Modern floppy drives often have a capacity of roughly 1,440 K. This value is often referred to as 1.44 M. The term Megabyte is often abbreviated Meg, M, or Mb. Disk drives and memory capacity are often measured in megabytes.

3.5 The Gigabyte

Computer technology continues to increase capacity at an amazing rate. There are now disk drives available which are measured in gigabytes. A gigabyte is 1000 megabytes.

4 The CPU

The heart of a computer is a device referred to as the Central Processing Unit (Often abbreviated CPU). The CPU is the physical device where all the fancy processing we talked about in the essentials of computing happens. Every other device attached to a computer system eventually sends information to or receives information from the CPU. The basic kinds of instructions (like the add, store, jump instructions we played with earlier) are built into the CPU. The characteristics of the CPU determine what kind of computer you have.

4.1 Processor

There are two major types of processors being used in home computers today. Macintosh computers are based on a family of CPUs created by Motorola. IBM compatibles are based on a family of CPUs made by Intel. These different CPU flavors have completely different sets of instructions that they read at the simplest level. A program written to run on a computer based on the Motorola CPU will not run on a computer that uses an Intel chip. Each of these families of processors has a number of models available. The latest processor is almost always much faster than its predecessors, and more expensive. In the Intel world, for example, we have had the 8086, the 80286, the 80386, the 80486, and the 80586. Computer sales types refer to these processors as: 8086, '286, '386, '486, and Pentium processors)

Each of these processors has been roughly twice the speed of its immediate predecessor.

4.2 Speed

A cpu also has a speed rating based on millions of cycles a second. One million cycles in a second is referred to as a megahertz. Megahertz is usually abbreviated Mhz. In general, the larger the megahertz rating, the faster the processor will be. A 100 Mhz Pentium will be faster than a 66 Mhz Pentium. This rating system is only accurate when you are comparing computers with the same type and generation of cpu. A 25 Mhz 486 is faster than a 33Mhz 386(!)

4.3 Choosing a CPU

Since the CPU determines everything else about a computer, it is obviously pretty important. It would be possible to buy a computer and then learn that all the programs you want are written for different CPUs. To avoid this situation, you need to carefully think about what you want from your computer. Visit friends who have computers, look around in the stores, and think about what you really want your computer to do. Go to a software store and look at the programs on the shelves. They will almost always have a little sticker on the box explaining what kind of processor you need to run that particular program. If you see ten programs that you might purchase some day, and eight of them require a 486 or higher chip, an IBM compatible with a 486 or Pentium chip is probably the machine for you. If you really like the interface on Macintosh computers, and don't want to learn anything else, that might be your computer. After you have chosen the type of cpu, you will need to choose a speed. The faster chips are more expensive. Again, look at the software you will want to run. If you can get by with a computer running at 33Mhz, why buy anything faster? Certainly you have more options with a faster cpu, but think about what you will use the computer for. If you will be playing games or doing other graphics - intensive work, a high speed CPU is very important. If most of your time is spent with word processing, the speed is not such a factor. While using word processing programs, even the slowest computers spend most of their time sitting and waiting for the user to type in a character. A very slow computer by today's standards might cycle 33 million times a second. How fast do you type? A general guideline might be to buy as fast a CPU as you can afford, but to worry a little less about speed if you are just using your computer for word processing.

5 Input Devices

The CPU is a very powerful thing, but all it does is work with information. It needs to get this information from other kinds of devices. Any component of a computer system that sends information into the CPU is called an input device.

5.1 Read Only Memory (ROM)

Memory is like the banks of switches we have been thinking about that simply contain 1/0 binary patterns. Read Only Memory (abbreviated ROM) is a special kind of memory that cannot be changed. The most basic instructions for the CPU are built in to the ROM at the factory. To the end user, there really is very little to worry about regarding ROM. The amount of ROM in your computer doesn't really matter to you. All your programs and information will go into another kind of memory that we will learn about soon.

5.2 Keyboard

The keyboard is probably the easiest kind of input device to understand. When the user presses a key, a code is sent to the cpu, which translates the code into some sort of storage format (usually ASCII.) There is generally no way for the cpu to send information back to the keyboard, so it is an input only device. Usually, you buy a keyboard as part of a computer system, but there may be a reason you want a specialized model. Certain keyboards are designed to be more ergonomically safe to prevent Carpal-Tunnel Syndrome (a common malady of those who spend all day at keyboards.)

5.3 Mouse

Many modern computers rely heavily on the mouse. This is a small object, usually with a roller ball on the bottom, that can be dragged along the desktop. Mice usually have one or more buttons on them that can be activated with the hand controlling the mouse. As the mouse is moved on the desk, a pointer moves on the screen. This mouse pointer is analogous to the user's hand. Many find this a more natural way of controlling the computer than typing on a keyboard. There are a number of "mouse substitutes" available, but they all basically work in the same way. Laptop computers often have a small ball embedded in the keyboard that can be rolled so the mouse can be activated even when the computer is being held on the user's lap.

5.4 CD-ROM

The same kinds of technology that enable us to store music digitally on compact disks allows us to store other kinds of information on the same medium. Compact Disks essentially store numbers. They are inexpensive to create, and can hold large amounts of information. (600 Mb) CD-ROMs are frequently used to sell software which has become too large to fit on floppy disks. Unfortunately, a CD - ROM cannot be written to with typical home technology. The ROM part of CD-ROM refers to this characteristic. A CD - ROM is an input device because it can send information to the CPU, but the CPU cannot send information to it.

CD Drives are measured in comparison to the speed of music CDs. An audio CD always runs at a constant speed. A 2X CD drive is twice the speed of an audio CD player. 6X and 8x drives are available at this writing. Even these drives are not as fast as typical hard drives.

Erasable CD drives are becoming popular, because they hold as much information as a regular CD, but the user can store things to them as well as reading from them. Such devices will probably be much more prevelant as their price comes down and reliability improves.

5.5 Other Input-Only devices

There are other devices available for input, but they tend to be specialty devices. Some examples are:

- Touch - sensitive screens for mall kiosks.

- Adaptive keyboards for individuals with physical disabilities
- Infrared mice for a mouse without cords
- Special presentation devices that allow a speaker to send input to the computer while delivering a presentation away from the keyboard.

6 Output Devices

Another category of devices is designed primarily for output. These devices get information from the cpu, and send it somewhere.

6.1 Printer

Printers take information from the CPU and transfer it to paper. There are a number of different printer technologies available.

Dot Matrix Dot Matrix printers are inexpensive and reliable, but they are loud and slow. They do not have nearly the print quality of some of the other types of printers.

Ink Jet Ink Jet printers squirt small streams of ink onto the paper. They tend to be slightly more expensive than dot matrix printers, but the quiet operation and improved print quality make them very popular with buyers of home computers. Some ink jet printers can make color prints. These can be very entertaining, but the ink becomes expensive.

Laser Printers Laser Printers use a combination of laser and copying technology to make very clear copies. Laser printers tend to make clearer copies than the other types of printers, and operate much more quickly, but they can be quite expensive to purchase and maintain.

Many people try to save money on a printer purchase and are disappointed. If the main reason you will use your computer is to type letters, remember that the people you write to will not see your monitor. What they will see is only what comes out of your printer. If printed documents are an important part of what you will use a computer for, consider a higher quality printer. Ink Jets are probably most appropriate for home use, and laser printers are more popular in an office setting. A dot matrix machine is fine for test printing or use on a kid's computer, but you will be disappointed with the results if you try to use it for business correspondence.

Before buying an ink jet, find out how much the ink cartridges cost, and how long they tend to last. With a laser printer, be sure to check on the cost of toner cartridges.

6.2 Monitors

The monitor is the part of the system that you look at most of the time. Monitors resemble televisions. Most computer monitors use the same technology as televisions, but with much higher resolution. Often the monitor will come packaged with a computer system, but you may wish to upgrade.

6.2.1 Size

The size of a monitor can make a big impact. You might get a headache squinting at a screen that is too small. The size of a monitor is measured in diagonal inches. a 15 inch monitor is 15 inches diagonally from corner to corner of the screen.

6.2.2 Dot Pitch and DPI

Monitors are also measured by their precision. There are two main measures, Dot Pitch, and DPI.

Dot pitch is a measure of the size of each tiny dot the monitor can display. The smaller each dot is, the nicer the picture will look, but the more expensive the monitor will be. When discussing Dot Pitch, SMALLER IS BETTER!!

DPI stands for Dots Per Inch. As you can guess, the smaller the dot pitch rating for a monitor is, the more of those tiny dots you could squeeze into a square inch. If you are considering DPI, LARGER IS BETTER.

Computer sales people are not above taking advantage of this confusion.

6.2.3 Video Controller Card

Dealing with graphics takes a lot of work. Modern computers usually have a separate computer built in just to help with controlling the monitor. This little computer has its own cpu and memory! The power and speed of this little computer, as well as its memory capacity, have a huge effect on how graphics are drawn to your screen. This little computer is referred to as a graphics controller card. The most common cards now are called SVGA. (You really don't need to know what it stands for but here goes: Super Video Graphics Array). Of course it gets way more complicated than this, but all you have to know is that there are fancier cards that do more and cost more, but you may not need the fanciest one out there for your first computer.

7 Devices that do Input AND Output

Some of the most important parts of the computer system can do both input and output. These devices have a sort of 'two - way - street' relationship with the CPU. Information can flow back and forth between them and the CPU.

7.1 Random Access Memory (RAM)

RAM is perhaps the most important of the input/output devices. When we talk about computer memory, we are mainly talking about RAM. In this class, when we think about the banks of light switches that can be manipulated, we are thinking of RAM memory. The term Random Access is pretty unfortunate. There is nothing random about how memory is accessed. The program running will determine what is in memory. (of course, the program itself is in memory too!) RAM can be read from by the CPU. This means that the CPU can 'look' at any address in RAM and get the contents of that address. It can also be written to by the CPU, meaning that the CPU can change the value of memory cells on the fly.

One VERY important aspect of RAM memory is that it requires power. RAM can only hold values while power is going through it. If the power is interrupted, the RAM will lose ALL the values in it. This is why it is so important to save your work frequently when working on a computer. RAM memory is volatile. When the room you are working on is hit by a tsunami and the power goes out of your computer, you lose everything that was in RAM. This could be bad. The answer is to make copies of RAM, and place these copies on other kinds of media. That's what disk drives are for. (see below...)

The amount of RAM in your computer is obviously a pretty important factor. The more memory you have, the more 'room' there is in your computer for information and programs. Modern programs have gotten HUGE, and the kinds of information you can work with have gotten much larger. Some early home computers had 4 or 16 K of RAM. The original IBM PC had 640 K of RAM. In its day, this was thought of as an extravagant amount of memory that would never be fully used. Modern computers with less than 16 Megabytes (16,000 K) are considered a bit lame. (pun completely intended.) Older computers can be quite happy with much less RAM, but they will not be able to run the newer programs.

If you are buying or upgrading a computer, you should seriously consider as much RAM as you can afford. There is probably no more cost-effective upgrade than RAM.

If you find that you need more memory, It is relatively cheap and easy to do a memory upgrade. Note that not all types of RAM are interchangeable. Look in the book that came with your computer for specifically which type of RAM you need when you are ready to upgrade.

Most of the time when we speak of memory, we are only thinking of RAM. In computer advertising, RAM is sometimes referred to as DRAM for Dynamic RAM

7.2 Disk Drives

Disk drives are special devices that allow us to make copies of parts of RAM and store them magnetically. If RAM memory is electronic, think of disk drives as a special kind of magnetic memory. When you save something to a disk, the electronic impulses in RAM are copied and stored to the disk as a series of magnetic impulses. All a disk drive does is translate electronic impulses and magnetic impulses back and forth.

Disk drives are handy because magnetic impulses are more permanent than electronic ones. The disk drive does not require electricity to keep values in memory, so if you store something to a disk, the information will be there when the tidal wave knocks the power out to your computer. (Assuming, of course, that the disk stayed dry and clean) Disks are sometimes thought of as secondary storage for this reason.

There are a number of different kinds of disks. We will discuss a couple of main types:

7.2.1 Floppy Drives

A floppy drive is a machine that is designed to read floppy disks. Floppy disks are the removable devices that you stick in slots in the front of the machine. I know, they look square, not disk-shaped, and they don't look floppy at all, but they are indeed floppy disks. Floppy disks come in hard plastic cases to make them a little more sturdy and easier to handle, but inside the plastic case, there is an actual disk. It is made of a plastic-like substance called mylar which really is floppy. Floppy disks come in two main sizes; 5 1/4 inch, and 3 1/2 inch. The 5 1/4 disks are becoming obsolete, but you still see them from time to time. The 3 1/2 inch disks, although physically smaller, can usually hold more information!

There are different flavors of floppy disks. In a modern computer, the only kind of floppy you need to purchase is High Density 1.44 MB. As you can guess, they hold 1.44 MegaBytes of information, which is a pretty good amount. (You could hold several hundred pages of text or about a dozen full color pictures on a 1.44 MB disk) This type of disk may carry some other markings as well, such as DSHD or HD. The HD is the important part. That tells you it can handle 1.44 MB. If you have an older computer, you may find that it needs a different type or size of disks. Check your documentation to be sure.

7.2.2 Hard Drives

A hard drive is a special disk that is usually mounted permanently inside your computer's cabinet. You rarely see the hard drive, and almost never take it out. Hard drives are made of different material than floppies, and they are physically hard (although if you touched the actual hard surface, you would destroy it!) They spin much more quickly than floppies, and require much more precision. They are sealed inside a special case, and that is sealed inside the computer case. A hard drive has a much larger capacity than a floppy, and is much faster at saving and retrieving information. Modern computers frequently have hard drives with 500 MB or more of capacity. As this capacity grows, people are beginning to measure it in terms of gigabytes. Software programs are always becoming larger and taking more room on hard drives. It never takes long to completely fill up the capacity of a drive. If you can afford a large drive when you buy the computer, you won't be sorry, but you can usually add another drive or upgrade later.

7.2.3 Fancier kinds of drives

There are a number of other types of drives you may encounter when buying or upgrading a computer. You may encounter such things as Bernoulli tape drives, WORM (write once, read many) drives, optical floppies, and removable hard drives. All these things are really cool, but you may want to stick with the basics until you are a little more comfortable with the technology. Any computer system ought to have at least one 3.5 inch floppy drive, as large a hard drive as possible, and a CD-ROM drive.

7.2.4 Drive Controller Cards

Most computers come with a small card installed that helps control all your disk drives. It is called the Drive Controller Card. (Wow, those computer scientists have some kind of imagination, huh?) You really don't need to worry about this device very much. There are two major kinds, IDE and SCSI. The only time you will ever care about this is when you buy a hard drive. Just know that the terms IDE and SCSI (pronounced 'scuzzie') are terms that describe the drive controller card.

7.3 Network Card

In a home computer, you will generally not have a network card, but these devices are very common for computers in office settings. A network card is a special card which allows your computer to talk to other computers that are physically attached via cables. Depending on how the network is set up, you can send messages from computer to computer, run programs that are stored on different computers, and share devices like hard drives and printers. In many offices, the network also gives you access to the Internet. Network connections are generally faster than modem connections.

7.4 Modem

Modems were once thought of as somewhat extravagant, but with the advent of the Internet, they are becoming a necessity for home computers. They allow you to connect your computer to the Internet or other computer systems through a telephone connection. The term Modem stands for Modulator / Demodulator. It is a device that converts back and forth from the digital signals that computers understand to analog signals (sounds) that can be transferred over telephone lines. Modems can be internal or external. The external ones have their own little case and power supply, and are generally a little more expensive than the internal ones, which are little cards that fit inside the computer. Modems are rated by their transmission speed, which is measured in BAUD (Bits of Audio Data / Second). If you want to do any Internet connections, you need a baud rate of 1440 BAUD (also sometimes called 14400 BPS or 14.4 KBPS) You can also purchase faster modems, but they are of course more expensive. In the near future, something will happen in this arena. It is likely that we will be switching to a completely new kind of communication technology for home computers, but nobody knows exactly what that will be just yet. Some modems also include faxing and voice mail capabilities. These features can be very convenient for people with home offices.

7.5 Sound Card

Sound cards are another peripheral device that was once thought to be extravagant, but is now pretty much standard equipment on any new machine. A sound card is a device which enables the computer to handle sounds (duh!). It can handle sounds in two major ways. It can create sound effects entirely through programming, or it can record sounds through a standard microphone. Sound cards are attached to speakers which recreate the sound. Obviously, sound cards are a big boost to computer game players, but they are frequently being used for more serious pursuits as well. People can attach voice annotations to documents they have written, musicians can test and modify a composition with a computer, and people with visual disabilities can have screens of text read to them. The basic sound card is referred to as an 8-bit sound card, because it processes 8 bits of information at a time. You can now find 16-bit, and even 32-bit sound cards if you are willing to pay for them. As always, it depends on what you want your computer to do for you.

8 Buying a computer

All those details are very confusing. Computer sales people know this, and take advantage of it. If you generally followed most of the things we've talked about in this chapter, but you still don't know IDE from SCSI, don't worry. You still probably know nearly as much as the salesperson you are dealing with. Much of the time, salespeople deliberately go into heavy jargon-speak. Don't let that intimidate you! You know the basics of what a computer should have, and you should know what you want. You are the one with the money, and they have to please you. Here are some guidelines.

Decide if you are ready for a computer. Maybe you aren't yet. That's OK. Wait until you are.

Decide HONESTLY what you think you will do with a computer. Everyone says "Oh, I'm mainly going to write letters and balance my checkbook." Malarky. If you want to be able to play games, surf the Internet, and run that really cool game you saw advertised last week, you don't have to admit that to anyone else, but admit it to yourself. If all you are really going to do with your computer is basic applications, you don't need much of a computer. If you want to run the newest, coolest applications, you need a more elaborate setup that will cost you more money. The best way to find out the right machine for you is to go to a software store and look at the shelves. Pretend you were given enough money to buy any 5 programs in the store. Look at the boxes the programs come in, and you will see a section somewhere that describes the minimum equipment requirements for that program. After you have compared a few such programs, you will begin to see what kind of computer you really want to have. If all the programs you want require a 486 or Pentium, you will probably be disappointed with a 386 or a Macintosh. It might be that all the programs you want will run on a 486, but you need a CD-ROM. That should guide you in your decision process as well.

Think also about the ease of use factor. As we explore operating systems in this class, think about which one you like best. How important is that to you. Many people are sold on Macintosh simply because they love the operating system, although there is much less software available for the Macs.

Finally, think about compatibility. This is not nearly as big an issue as it used to be, but it can still be a factor. For example, if you are a teacher, all the work you do at school is on a Mac, and you want to be able to work at home as well, a Macintosh similar to the one at work makes sense. Likewise, if you are an accountant, and you want a copy of Peachtree at home, you will probably need a PC. Remember that the Internet is making compatibility less of an issue, but it still is a factor.

Think about how much money you have to spend. Since the beginning of the home computer boon, the top - of - the line home computer system has always cost about \$3000. (Of course the machine you spent \$3000 on in 1983 is worth about a dollar and a half today, but that is irrelevant). If you have $3000 sitting around, your decisions are easy. Most of us have to compromise somewhere.

Any computer system you buy today will be obsolete in a few months. You can't sit there waiting for the market to settle down, because it isn't going to happen. Accept the fact that you may not have the best machine out there, and get the best machine for you you can afford.

Consider an older or used computer. If you don't mind using an older operating system and programs, they can serve you well. Systems that cost several thousand dollars a few years ago can now be found quite cheaply. It will be harder to find programs for them, but once you do, you can suffice quite nicely. Used computers can sometimes be found at used computer stores, and sometimes offices sell older but still very serviceable computers to their employees at very reasonable rates. You may also want to check the want ads. You might find a very good deal on a computer fully stocked with software and peripherals. These older cheaper computers are ideal for college students and others with enforced poverty levels.

Think about whether you want a laptop. Laptop computers are those amazing computers which are just as powerful as their desktop cousins, but small enough to fit in a briefcase. The obvious advantage of a laptop is portability and convenience. With batteries, a laptop can be taken nearly anywhere. If you are willing to pay for it, you can find a laptop computer as powerful as nearly any desktop anywhere.

There are two main problems with laptops. In order to fit such power in such a small space, the designers of laptops often have to squeeze things together in unusual creative ways. This makes laptops generally more expensive than desktops, and also makes them more difficult to upgrade. On a desktop computer, you can simply remove the top, take out a card, and replace it with a new one. Laptops are generally made so the user cannot take them apart and cannot do many upgrades at all. A standard called PCMIA improves this situation, but PCMIA - based devices for laptops are much more expensive than the same device designed for a desktop machine.

Comparison shopping is important. For one thing, you can use the information you learn on earlier searches to make you sound smarter later on. You might start by finding a computer you like, then writing down the specifications for it. The next store you go to, you don't have to say "Gosh, I want a computer-thingy." Instead, you can say "I'm looking for a Pentium 100 or better with 15Mb of RAM and at least a 500 Mb Hard drive." Even if you don't find the computer there, the sales person is far more likely to take you seriously and meet your needs.

9 Deciphering the ad

Remember the advertisement from the beginning of this chapter? Let's look at it again:

120MHz Pentium Processor This computer has a relatively new processor, it is IBM compatible, and it runs at 120 million cycles a second, which is pretty fast.

16MB DRAM It has 16 megabytes of RAM, which is plenty for now, but we may need more later.

850MB 10ms IDE HD It has a hard drive that can store 850 megabytes of information. Again, that's pretty big, but we may still need more space later.

1MB DRAM 64-bit PCI Graphics Accelerator Video Card It has a nice video card with 1 megabyte of its own memory.

8X CD-ROM It has a CD drive that can run 8 times faster than audio CDs.

3.5" FD It has a standard floppy disk drive. Boring but still important.

16 bit Soundblaster Compat It has a standard sound card.

28.8 Fax Modem It has a built in modem that is pretty fast. The modem can also be used to send and receive faxes

15 inch Monitor, 15.28 dp It has a monitor that is 17 inches in diagonal, and the dot pitch value of the monitor is 15.28

7-bay mini-tower case It has room for up to 7 more devices, although some of these slots are surely being used by the modem, drive controller card, and so on...

10 Laboratory Assignment

- Your teacher will provide for you either an opened computer system or a picture of a typical system. Identify and label at least the following components of that system:
  - The CPU
  - RAM Memory
  - The Motherboard
  - The expansion slots
  - The Hard drive
  - A Floppy drive
  - The Keyboard
  - The mouse
  - The monitor
  - The device / driver controller card
  - The power supply
  - Serial / Parallel ports
  - Any other special cards or devices attached to the machine
- 'Practice' purchasing a computer. Decide on a reasonable budget. Determine what kinds of things you want to be able to do with your computer. Which programs will you need to be able to run? Write down the specifications of at least three kinds of software you would like to be able to run on your new computer. Go to computer stores and magazines, and find a computer that will run that particular software. How much will it cost? Will it do what you want? Use a word processor to write out answers to all the above questions with a narrative of the shopping experience.

- Decipher a computer advertisement. Your instructor will give you a computer advertisement, or you can seek one out from a computer store or a magazine. Write down all the 'code words' for that computer. Translate each code phrase into its meaning in English. If you don't know a particular phrase, make an informed guess (try researching before making a completely blind guess). Use a word processor to write out this process in a table form and turn it into your teacher.

Hardware The physical part of the computer system you can see and touch

Software The data, programs, and other esoteric parts of the system that do not have a physical presence

Bit One on/off unit. The basic unit in a computer system. The value of a bit can be 0 or 1.

Byte Eight bits. A byte is large enough to hold one character in ASCII

Kilobyte 1024 bytes. Used to measure memory and disk capacity. Often abbreviated K or Kb.

Megabyte 1000 Kilobytes. Used to measure memory and disk capacity. Often abbreviated Meg or Mb.

Gigabyte 1000 Megabytes. Used to measure large disk drives. Usually abbreviated Gig.

CPU Central Processing Unit. The 'heart' of the computer. The characteristics of the CPU have profound effects on the performance of the entire system. CPUs are measured by their chip name and speed.

Intel The manufacturer of IBM - Compatible CPUs. The modern Intel chips are: (from oldest to newest) '386, '486, Pentium.

Motorola The manufacturer of Apple Macintosh CPUs. The current Motorola CPU is the PowerPC chip.

Megahertz A unit of measure for processing speed. One Megahertz is one million instruction cycles per second. Megahertz is often abbreviated Mhz.

Input A device or process that goes into the CPU from somewhere else.

Output A device or process that goes from the CPU to someplace else.

ROM Read Only Memory. A special type of memory that has information stored on in from the factory. The user cannot change the information in ROM.

Carpal-Tunnel Syndrome One of a number of repetitive stress disorders that can be caused by frequent typing. Careful posture and hand positioning, as well as some adaptive devices like wrist pads and special keyboards can minimize the effects of this type of problem.

CD-ROM A drive / disk combination that allows the user to retrieve information stored on compact disks. Most Current CD drives do not allow the user to write on them, but such technology is becoming more popular and less expensive.

Impact Printer A type of printer that operates by striking the paper with an inked ribbon. Reliable and inexpensive, but slow and loud, and with limited resolution.

Dot-Matrix Printer The most common type of impact printer.

Laser Printer A device that combines printing and copying technology. Relatively expensive to operate, but fast and very high resolution.

Ink Jet Printer A printer that operates by squirting precise jets of ink onto the paper. They are relatively inexpensive, and have nearly as much quality as Laser Printers, but they are slower.

Dot Pitch A unit of measurement describing the resolution of a monitor. A small dot pitch number means a clearer monitor.

DPI Dots Per Inch. Another unit of measure for the resolution of a monitor. A large DPI value means a higher quality monitor.

VGA, SVGA Types of video controller cards. Almost all modern Intel - based computers handle some form of SVGA (Super Video Graphics Array).

RAM Random Access Memory. This is the memory that can be manipulated by the user and programs. The amount of RAM in a computer is an important performance factor. Usually measured in MB. Sometimes also referred to as DRAM.

Floppy Disk A portable storage medium which can be removed from the computer. Floppy disks currently come in 3 1/2" and 5 1/4" sizes. Even though a 3 1/2" disk appears to be hard, it is NOT a hard drive.

Floppy Drive The machine installed in the computer console which reads and writes from floppy disks. Usually measured in Kb or Mb.

Hard Drive A permanently installed drive with a much larger capacity than floppy drives. Usually measured in Mb or Gig.

IDE, SCSI Types of drive controller cards. Most PCs come with IDE controllers.

Network Card A device that allows you to attach your computer to other computers in the same general vicinity.

Modem A device that allows you to attach your computer to remote computers through analog telephone lines. Measured in Baud or Kilobaud.

Sound Card A device which enables the computer to generate or duplicate sounds. Usually attached to speakers and a microphone.

Baud Bits of audio data/ second. Modern modems are usually 14,400 or 28,800 baud. Sometimes also referred to as BPS (Bits Per Second.)

PCMIA A standard for connecting external devices to laptop computers.

11 Summary

The terminology of computing hardware can be staggering. The technology changes so quickly that it is difficult to describe computing equipment. This has contributed to the fears of first - time computer buyers.

Fortunately, there are some key concepts that can be used to help decipher all these frightening terms. Knowledge of the major units of measure and the major types of computing hardware will make you a smarter computer shopper.

When buying a computer system, it is critical to carefully evaluate what you want to do with your system, and which software packages you want to run. With some care, you can purchase a system that meets your needs without spending too much money.

Answers to Questions

1. Each piece of the ip address is limited to 255 because it is represented by one byte. There is really no limit to the number of addresses we could have, because we could simply add another byte onto the end. As it is, the addresses are comprised of 4 bytes, with a total of 256^4 possible values (4,294,967,296) There are many possible values, and a conspiracy here is not likely.

2. Each dot on the screen is represented by one byte in memory in such a system. This would mean 256 possible values. (Don't forget to count the zero!)

3. In ASCII, each character is stored in one byte, so 500 characters would be 500 bytes. Your editor might save tabs and document information in special ways, so your mileage might vary.

4. Roughly 720,000 bytes To be more precise, 720 * 1024 = 737,280

   To figure the number of bits, multiply the bytes by 8: 737280 * 8 = 5,898,240